Incipient Invasive Species Control and Outreach in the Ko'olau
December 1, 2020 – December 31, 2021

2021 Final Report to:

HAWAII INVASIVE SPECIES COUNCIL

Prepared By:
KO'OLAU MOUNTAINS WATERSHED PARTNERSHIP

INTRODUCTION

The Koʻolau Mountains Watershed Partnership (KMWP) is a project of the Pacific Cooperative Studies Unit (PCSU) with the University of Hawaiʻi (UH) that addresses island-wide conservation issues by working with public and private conservation groups, state, municipal and federal agencies, and private landowners. KMWP's mission is to perpetuate the water resources of Oʻahu by protecting and enhancing the forests of the Ko'olau and its invaluable native ecosystems. The Koʻolau Mountain Range has one of the highest densities of rare species in the world. The area provides habitat for dozens of endangered species, many of which are endemic to the range and found nowhere else in the world.

Poamoho is an area in the northern Koʻolau Range that provides habitat for 11 animal species and 18 plant species that are vulnerable to, or have a high risk of, extinction. The Oʻahu Army Natural Resources Program discovered the highly invasive cane ti (*Tibouchina herbacea*) in the Poamoho region in 2008. Since 2016, KMWP has worked to conduct control, monitoring, and delimiting surveys for cane ti along Paukauila stream, which runs through the Poamoho Natural Area Reserve across Kamehameha Schools lands.

The Waiawa Management Unit (MU) is an approximately 1,500-acre area and is currently being fenced to prevent ungulate damage. Waiawa is dominated by native wet forest and is categorized as a priority 1 watershed by KMWP based on rainwater data from UH and usage assessment by the Honolulu Board of Water Supply. This watershed feeds into the Pearl Harbor Aquifer, where Oʻahu gets the majority of its drinking water. Albizia (*Falcataria moluccana*) is an extremely fast-growing tree species and was planted as part of early reforestation efforts in 1917. Since that time it has come to dominate significant portions of urban/forest interfaces, riparian zones, agricultural land, critical infrastructure corridors, and low- to medium-elevation forests on Oʻahu. Since 2018, KMWP has been working to achieve regional eradication of all albizia across

the MU. Although target numbers are relatively low, the effort required to control individual trees is high. Access to target trees requires helicopter flights into the area and up to a full day of hiking to traverse across densely forested, steep terrain. Though efforts to control these incipient trees have been relatively substantial, they are insignificant when compared to the future costs of attempting to control robust and dominant albizia populations.

For the past six years, KMWP has been utilizing the scale insect *Tectococcus ovatus* as a biocontrol to reduce the impact of the invasive myrtle *Psidium cattleianum*, or strawberry guava, on native forests. Tectococcus shares a native range in South America with strawberry guava and hinders its host plant's growth through the formation of leaf galls. In years leading up to this project, with the assistance of source material from the Hawai‘i Division of Forestry and Wildlife, KMWP outplanted host plants inoculated with Tectococcus across 31 sites spread throughout the Ko‘olau range. As the methods for effective utilization of this biocontrol were still being developed during this period, the success of these introductions was mixed, with some locations showing significant spread of Tectococcus onto surrounding stands of guava, and others unable to establish lasting populations at all. Only 11 of these 31 sites remain as effective centers of Tectococcus populations. This project sought to utilize new techniques and information from the US Forest Service, Hawai‘i Division of Forestry and Wildlife, and the Hawai‘i Department of Land and Natural Resources, in addition to researching and developing novel methods in-house, to increase Tectococcus' impact on O‘ahu.

GOALS

The goals of this project were to:

- Reduce the impacts of invasive species on priority watersheds
- Protect water quality and supply for communities and agriculture on O‘ahu
- Improve habitat quality for at-risk species
- Increase public awareness on O‘ahu with regards to general species information and the damage that can be caused by albizia trees

EXPECTED OUTCOMES

1. Incipient Cane Ti Control

- Two surveys per section per year completed for the upper 7 sections of Paukauila Stream.

2. Incipient Albizia Control

- Two days of on the ground control and surveys completed. Depending on ability to combine efforts and leverage staff and helicopter time with other projects in the Waiawa MU, total regional eradication from the area is expected by the end of the project period.

3. Albizia Outreach

- Continued Participation it the Statewide Albizia Working Group
- Creation of O'ahu-specific albizia outreach materials
- One presentation to a community group on albizia impacts and control methods

- One volunteer event with a community-based control team

4. Tectococcus ovatus *Biocontrol Deployment*

- One map created to determine gaps in biocontrol agent establishment sites
- T. ovatus established at 5 new sites
- Development of initial sUAS methods for T. ovatus agent delivery

Summary

1. Incipient Cane Ti Control

Two sets of surveys of the upper 7 sections of Paukauila Stream were conducted roughly six months apart, covering a total of 46.1 acres and controlling 87 cane ti plants (figure 1). These surveys were supplemented by funding from the Watershed Partnership Protection Grant (WPPG) to allow for two more sets of surveys of the same 7 sections, providing for quarterly control operations, as well as two more partial sets of surveys for the lower 7 sections of the stream. These surveys along the lower sections were curtailed to divert funding to allow for ground control of a windward core, discovered in 2020, outside of the stream. Management of this newer population, which has resulted in a steady decline in plant numbers, will continue with additional WPPG funds.

2. Incipient Albizia Control

In accordance with the expected objectives, resources from other projects in the Waiawa MU were leveraged to allow for a total of 4 days of albizia control in the area, totalling 29.7 acres of management and the removal of 37 trees (figure 2). All identified trees in the MU were removed, prompting an expansion of the MU onto the US Fish and Wildlife forest reserve covering the majority of the northernmost valley that contributes to the Waiawa watershed. Removal of the trees remaining in this area will achieve full regional eradication of the species from the upper elevations Waiawa. Future monitoring will need to be conducted in order to identify incidents of re-establishment, which can eventually be expected due to the possibility of small, immature trees hiding under dense canopy cover, as well as populations at low elevations along windward slopes east of Waiawa dispersing seed back into the MU.

3. Albizia Outreach

The Rapid Albizia Death (RAD) hui was established as a way to empower lay community members to manage albizia populations on their own, following instruction and demonstrations from KMWP staff. A flier, adapted from educational materials developed by James Leary, J.B. Friday, Springer Kaye, and Flint Hughes, was distributed to community leaders to inform them of established, effective management techniques (figures 3 and 4). Regular involvement with the Malama Manoa community board, where multiple presentations on the RAD hui have been conducted, and two volunteer events with local hui members have resulted in the control of 12 trees and identification of many more across 2,650 meters of stream running through residential Manoa. KMWP management continues to participate in the Statewide Albizia Working Group.

KMWP HISC21 Tibouchina

Projection: NAD83 UTM Zone 4N
Basemap: USGS OAHU DRG
Vector Data: KMWP
Scale: 1:15,000
Map Production Date: 1/27/2022

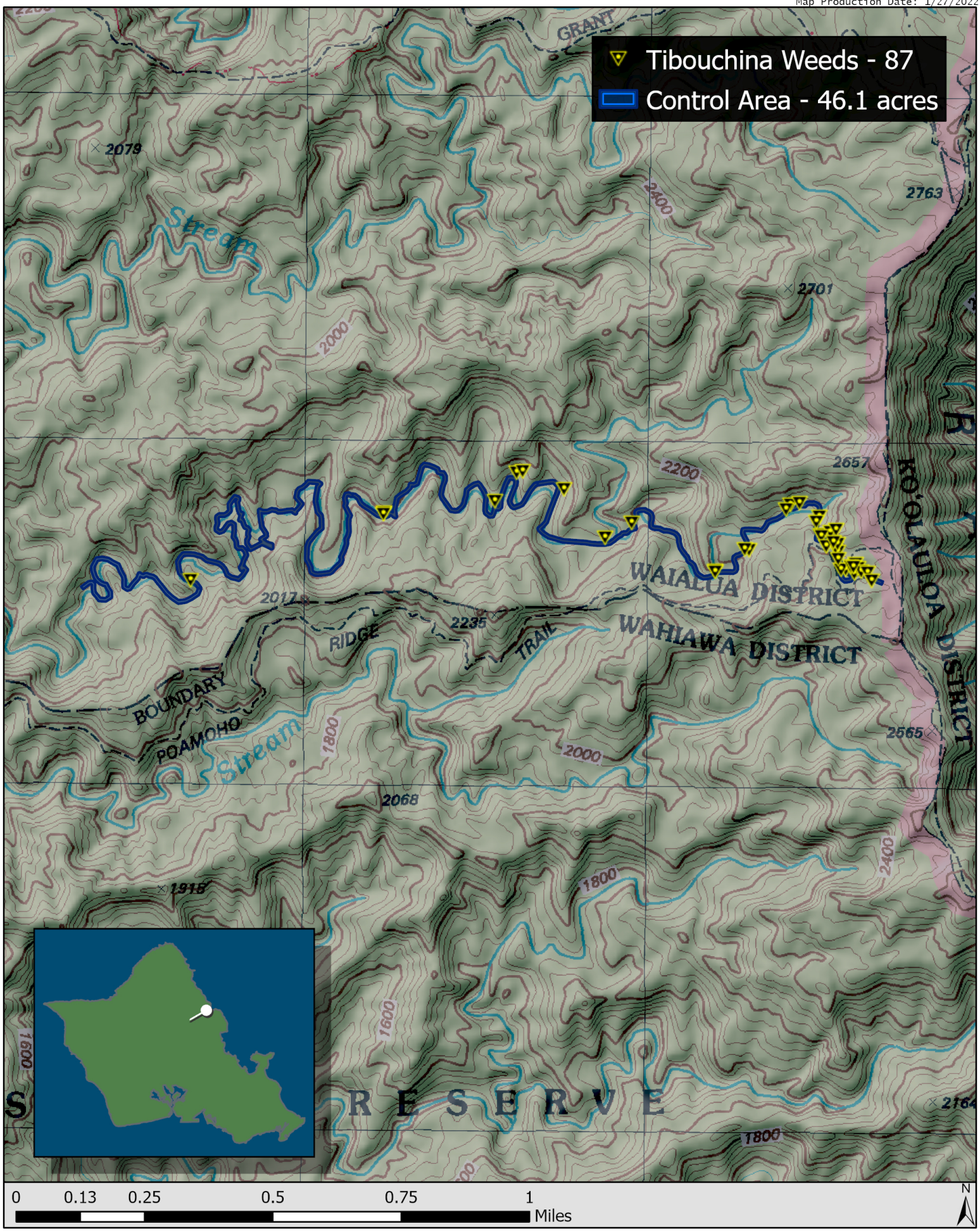


Figure 1. Map of cane ti removal efforts

KMWP HISC21 Waiawa Albizia

Projection: NAD83 UTM Zone 4N
Basemap: USGS OAHU DRG
Vector Data: KMWP
Scale: 1:25,000
Map Production Date: 1/27/2022

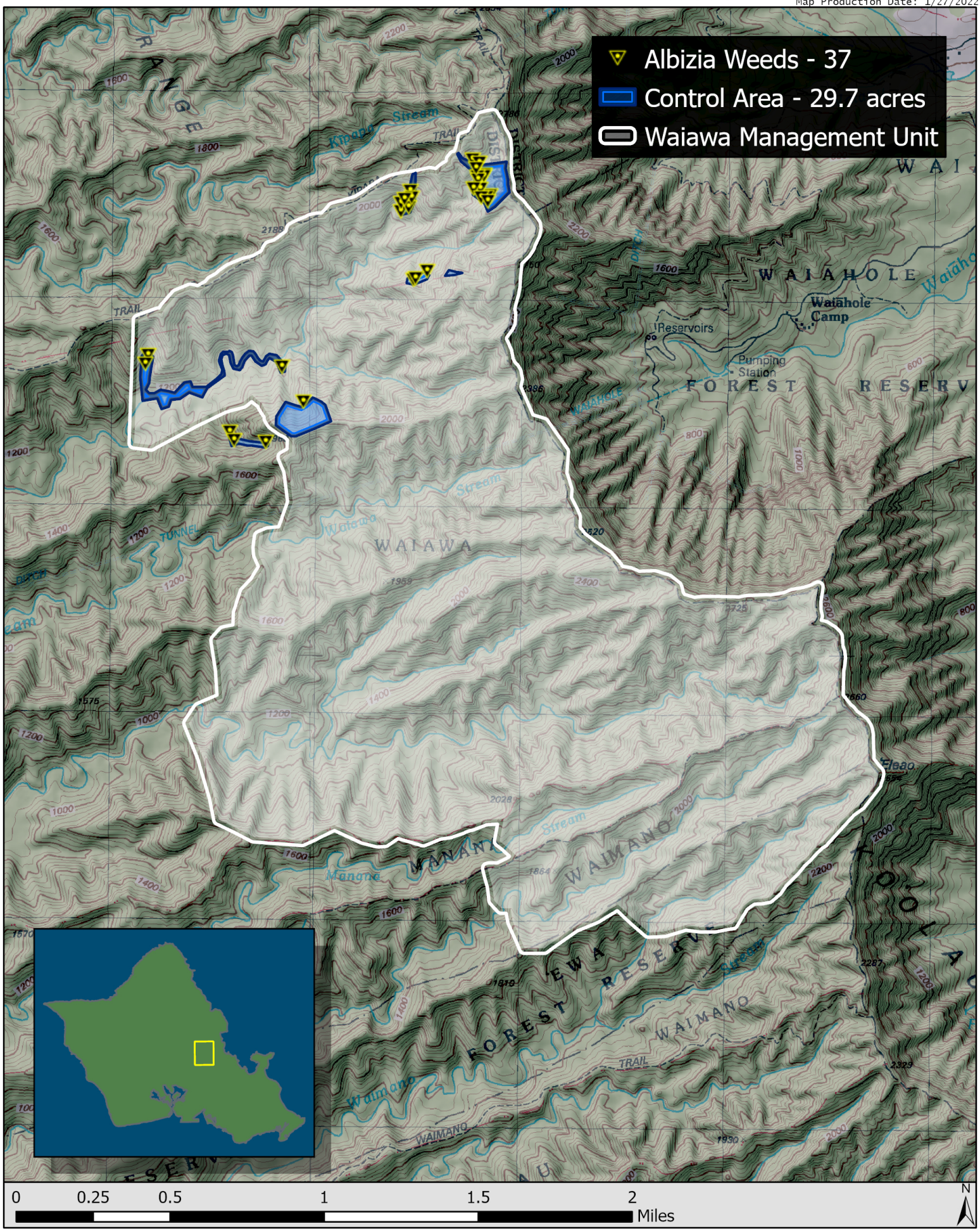


Figure 2. Map of albizia removal efforts.

Proper Technique for Treating Albizia with Milestone® Herbicide

This is an adapted version of the CTAHR Cooperative Extension brochure by James Leary, J.B. Friday, Springer Kaye, and Flint Hughes. Photo Credit to Ko'olau Mountains Watershed Partnership.

Basic Information

This guide explains how to effectively treat **NON-Hazard albizia trees** using Milestone® Specialty Herbicide, (EPA Reg No. 62719-519). It is a violation of federal law to use this herbicide in a manner inconsistent with its registered application methods.

REMEMBER...
ALWAYS READ THE HERBICIDE LABEL
THIS METHOD IS FOR NON-HAZARD TREES ONLY

Incision Point Application

Incision Point Application (IPA), is a calibrated and efficient technique for administering herbicide directly in the exposed vascular systems of woody species, like albizia.

Materials

- Hatchet/machete
- Drop dispenser bottles (1–8 fl. oz.)
- Milestone® Herbicide
- Tape measure
- Quick Capture app on smart device (see QR code)
- PPE: safety goggles, rubber gloves, long-sleeve shirt, long pants, closed toe shoes, & Ziploc bag for herbicide

Figure 1: Exposing the white sapwood (cambium layer), note the color change.

Methods

STEP 1. Measure the diameter (D) of the targeted albizia tree at chest height. Determine how far apart you will make your notches on the tree trunk ***(look to the back of this handout for measuring D and notch spacing)***.

STEP 2. At about 3 feet above the ground, use the hatchet to make a notch at a 45° angle, approximately 2-3 inches deep. This should penetrate just beyond the bark and into the white sapwood (Fig.1). Wiggle the blade to widen the notch as needed. Continue to measure and make notches around the circumference of the tree.

STEP 3. Put on rubber gloves and safety goggles. With a dropper bottle, deliver 0.5 milliliter (mL) of herbicide in the center of each notch ***(look to the back of this handout for calibrating your dropper bottle).*** Slowly deliver one drop at a time to prevent herbicide from overflowing from the notch (Fig. 2). Return dropper to its Ziploc bag. Do not handle other equipment with contaminated gloves, only the bottle.

STEP 4. Record treated albizia on Quick Capture app.

Figure 2: Slowly drip herbicide into the notch (use PPE).

Management

- Avoid the area as much as possible after treatment. Dead standing trees are brittle and can be dangerous to cut.
- Canopy defoliation (loss of leaves) is expected in 4 - 6 weeks.
- Canopy collapse (loss of limbs) is expected in 2 - 4 years.
- Sections of the standing trunk may remain for longer, and will continue to decompose for years to come.
- Some trees may require re-treatment if there is new leaf growth observed after 12 months.

Figure 3. Rapid Albizia Death hui Albizia treatment flier page 1.

Supplemental Information for Treating Albizia with Milestone® Herbicide

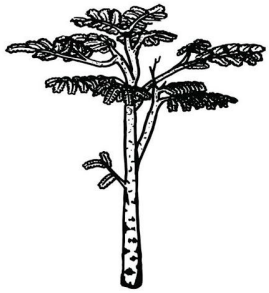
Graphics are NOT to scale.

How to calibrate your bottle dropper:

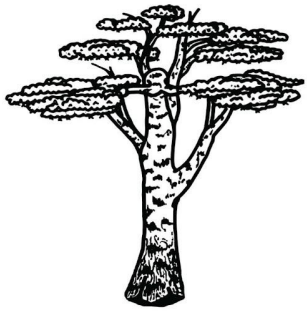
Calibrate before going into the field.
1. Fill your bottle dropper with water.
2. Using a 1/8 teaspoon (1/8 tsp = 0.5 mL), slowly fill the teaspoon and count the number of water drops dispensed until full.
4. Record the number of drops it took for future reference.

NOTE: If the bottle dropper was previously used for herbicide, DO NOT use the teaspoon for general household needs after calibration.

Tree sizes and measuring:



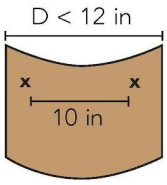
Diameter (D) <12 inches (in)
Circumference (C) < 38 in



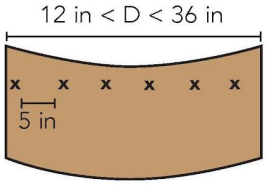
12 in < D < 36 in
38 in < C < 113 in

D > 36 in
C > 113 in

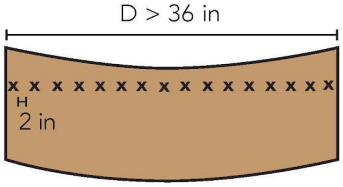
Measuring notch intervals based on tree diameter (D):



Notch every 10 in



Notch every 5 in



Notch every 2 in

Quick references:

Standard
5-gallon bucket

Standard 55-gallon
trash can

DO NOT USE IPA TREATMENT ON HAZARD TREES

For accuracy in measuring diameter or circumference, use your tape measure.
Here is a quick resource on tree measuring: bit.ly/measuretreediameter

Go to koolauwatershed.org/albizia for more information.

Figure 4. Rapid Albizia Death hui Albizia treatment flier page 2.

Figure 5. Community removal of Albizia in Manoa valley.

Figure 6. Ring-barked Albizia tree - an herbicide-free treatment method.

4. Tectococcus ovatus *Biocontrol Deployment*

Utilizing guava stands inoculated with *Tectococcus ovatus* through efforts in years prior as stock for fresh material for new introductions, KMWP was able to establish 21 new host sites across the Ko'olau in 2021 (figure 7). Existing site data, compiled from various conservation organizations, hosted, and managed online by James A. Cullison at the Hawai'i Department of Land and Natural Resources, was analyzed to determine the location of gaps in the presence of Tectococcus and prioritize their closure based on existing infrastructure and other KMWP objectives. Geospatial data was recorded for each site and added to the online database for reference by other agencies. Emphasis was placed on higher elevation locations, mostly found upwind of other guava populations within the context of normal trade wind patterns, to try and maximize passive spread by wind. In order to improve the likelihood of establishment, host leaves inoculated with the scale were spread as new leaves were flushing in the canopies of target sites.

Methods of introduction ranged from extremely opportunistic to planned out well in advance, utilizing specialized equipment. They included taping gall-bearing leaves to plants, tying them with twine, attaching a string of leaves to sticks fired out of a slingshot (Pocket Shot Circular Slingshot brand), and dropping them from the air with the use of a small unmanned aircraft system (sUAS / drone) equipped with a remote-drop hook. Results of each method will need to be monitored to check for long-term success, but initial observations of spread look promising.

Use of the drone for remote deployment was promising but wasn't without hardware issues. A DJI Mavic 2 Pro was equipped with a Drone-Sky-Hook brand Release & Drop remote hook to carry and release cargo (figure 8). The device is a 3D printed chassis with battery, servo-motor powered rotating hook, and a light sensor. It is quick to attach and remove, and only weighs 49g, making it an easy addition to a field operation. As with many commercially available remote hooks, it functions by monitoring LED lights used by the drone for visual identification during flight. Switching the lights on and off via the drone's remote control signals the hook to rotate. This releases the cargo, though in some instances the hook failed to rotate for undetermined reasons. Thin, biodegradable twine, roughly a foot long, was used to tie a string of inoculated leaves to the hook with a loop (figure 9). Downwards-facing object-avoidance sensors triggered alerts due to this, which caused the unit to initiate landing procedures when attempting to drop altitude without forward velocity. However, longer lines under such light loads, used to avoid tripping the sensors, carried greater risk of engaging with propellers, especially in windy conditions. To remain within FAA part 107 regulations, drones can't fly past visual line of sight, unassisted by tools such as binoculars, but the Mavic Pro 2 is capable of flying over a mile from its operator. The sUAS Release & Drop can easily disperse material at a distance, allowing for dispersal to occur simultaneously with other field operations, significantly reducing the cost and effort of distribution expansion. The effectiveness of this initial method will continue to be monitored.

KMWP New Biocontrol Introductions

Projection: NAD83 UTM Zone 4N
Basemap: USGS OAHU DRG
Vector Data: KMWP, DLNR
Scale: 1:100,000
Map Production Date: 8/2/2021

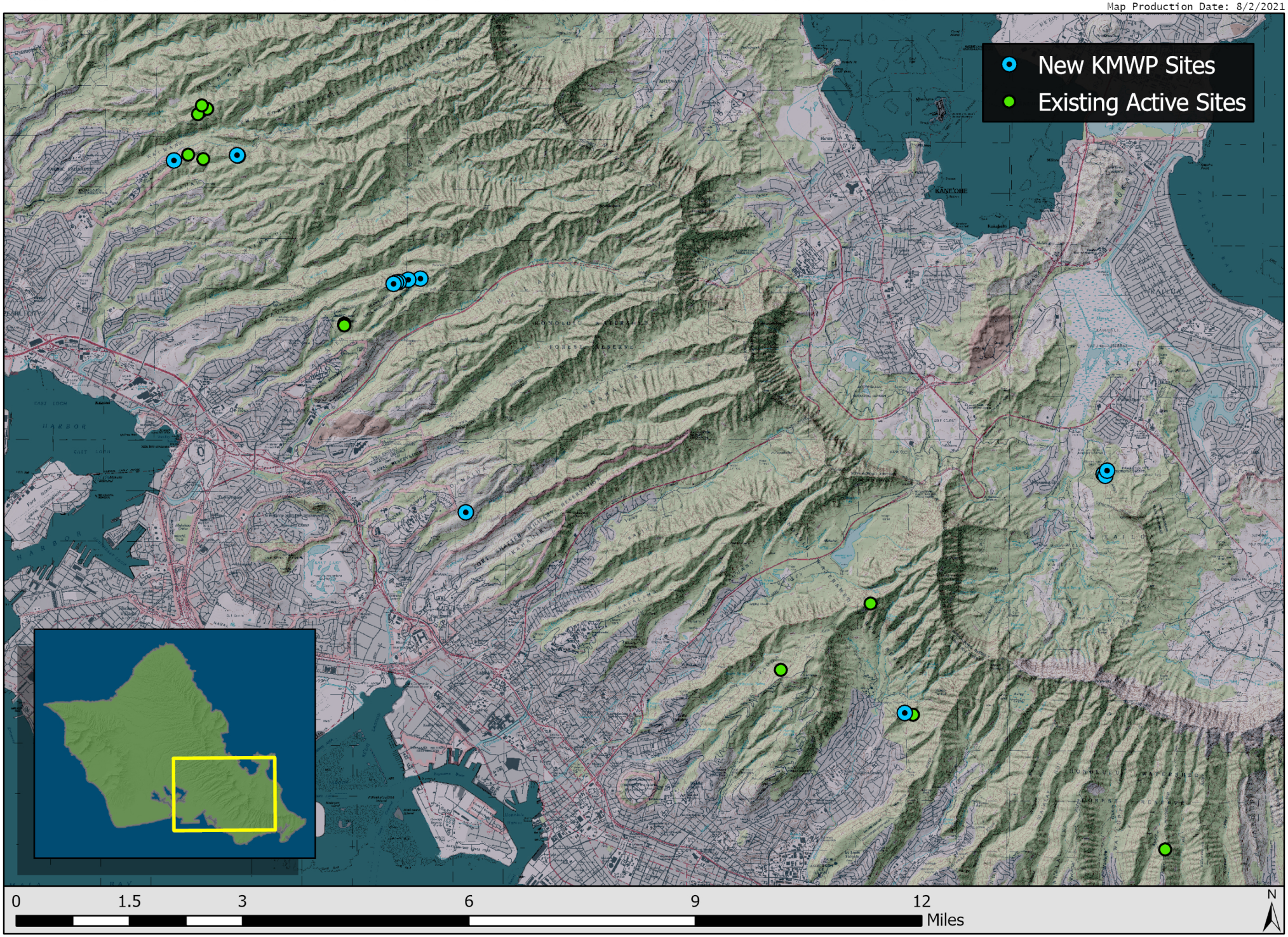


Figure 7. Map of locations KMWP released T. ovatus this year.

Figure 8. Drone-Sky-Hook brand Release & Drop remote hook mounted to underside of a DJI model Mavic 2 sUAS. A payload located under the drone is attached to the hook, exiting the bottom edge of the frame of the photo, while the cable to the light sensor exits the frame to the left.

Figure 9. Drone with Tectococcus ovatus *payload attached. With this configuration leaves have a lower chance of triggering downward-facing object avoidance sensors, but run the risk of hitting propellers. Care must be taken to not fly too fast or in windy conditions.*